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WATER SUPPLY AND WATER QUALITY CONTROL STUDY. TILLER AND GALESVILLE PROJECTS, UMPQUA RIVER BASIN, OREGON

Federal Water Pollution Control Administration
Portland, Oregon

September 1966

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WATER SUPPLY & QUALITY CONTROL STUDY

UMPQUA RIVER BASIN, OREGON

Tiller And Galesville Projects

SEPTEMBER 1966

UNITED STATES DEPARTMENT OF THE INTERIOR
Federal Water Pollution Control Administration

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WATER SUPPLY AND WATER QUALITY CONTROL STUDY

TILLER AND GALESVILLE PROJECTS

UMPQUA RIVER BASIN, OREGON

An investigation defining present and potential water needs for municipal and industrial (M&I) supply and stream flow needs for maintenance of water quality in Umpqua River Basin has been made. A need for additional source development for M&I supply and for storage for regulation of stream flow for water quality control is revealed. Future water requirements and quality projections are based on economic, demographic, and engineering studies.

Prepared at the Request of the

U. S. Army Engineer District, Portland
Corps of Engineers, Portland, Oregon

By the

U. S. Department of the Interior
Federal Water Pollution Control Administration
Northwest Region, Portland, Oregon

September 1966

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Details of illustrations in this document may be better studied on microfiche.

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I. INTRODUCTION

A. REQUEST AND AUTHORITY

The request for this investigation was made by the U. S. Army Corps of Engineers, Portland District, Portland, Oregon, in a letter dated May 25, 1965.

Authority for the investigation is: (1) the Memorandum of Agreement, dated November 4, 1958, between the Departments of the Army and Health, Education, and Welfare, relative to the Water Supply Act of 1958, as amended (43 U.S.C. 390b); and (2) the Federal Water Pollution Control Act, as amended (33 U.S.C. 466 et seq.).

B. PURPOSE AND SCOPE

The purpose of this report is to define the need for and the value of storage for municipal and industrial water supply and for water quality control in the Tiller and Galesville projects, currently under study by the U. S. Army Corps of Engineers.

The study area considered is the Umpqua River Basin, but particular attention has been given to the service areas and stream reaches of the South Umpqua, Cow Creek, and the main stem Umpqua that could be influenced by storage releases from the Tiller or Galesville sites.

Projections of future waste loads, water quality, and water use have been developed for 1980, 2000, and 2020, based on the resource potential of Douglas County, which almost coincides with the boundaries of the Umpqua Basin. Data used in the evaluation of flow requirements is taken from the Oregon Coast comprehensive studies being conducted by the Federal Water Pollution Control Administration.

C. ACKNOWLEDGMENTS

Information for this report was provided by officials of the communities and water districts studied, the Oregon Water Corporation, Douglas County Department of Water Resources, Oregon State Board of Health, Oregon State Water Resources Board, the Oregon State Sanitary Authority, the Oregon State Game Commission, the Oregon State Fish Commission, the U. S. Bureau of Sport Fisheries and Wildlife, and the U. S. Army Corps of Engineers, Portland District office. The assistance of these individuals is gratefully acknowledged. The use of information contained in the bibliography is also acknowledged.

II. SUMMARY of Findings and Conclusions

A. SUMMARY OF FINDINGS

1. The Tiller and Galesville multiple-purpose reservoir projects, proposed by the U. S. Army Corps of Engineers, are located in the Umpqua River Basin in southwestern Oregon. Both projects are located in, and will serve, the South Umpqua subbasin and downstream main stem Umpqua River areas. Project purposes being considered are flood control, municipal and industrial water supply, irrigation, fish and wildlife enhancement, water quality control, recreation, and power generation.

2. The South Umpqua River has a drainage area of 1,780 square miles and an average annual runoff of about 2.0 million acre-feet. Critical flow in South Umpqua River near Roseburg on a one-in-ten year recurrence frequency is 80 cfs, occurring in August and September. Water quality during times of such flows is detrimental to use of the South Umpqua for anadromous fishlife and recreation. Dissolved oxygen concentrations during the summer and early fall have dropped to 5 mg/l for periods ranging from several days to several weeks, and temperatures have averaged 75°F, with maximums over 80°F.

3. Total population of Douglas County in 1960 was 68,500. Over two-thirds of the total population (47,000) resided in the South Umpqua Basin--about 35,000 of whom lived in the Roseburg service area, the county's largest population center. Future economic growth in the Umpqua Basin, dependent on forest products industries and food processing, is expected to occur primarily in the Roseburg area. Basin population is expected to increase to 85,000 by 1980, to 106,000 by 2000, and to 132,000 by 2020. The Roseburg service area is projected to contain about 90,000 persons by 2020.

4. Present municipal and industrial water use is about 11.0 million gallons per day (mgd); over 60 percent of the demand is in the Roseburg area. Surface water is the primary source and, with treatment, is of suitable quality for M&I use.

Future M&I demands are projected to be 22, 29 and 46 mgd for 1980, 2000, and 2020, respectively. Future needs are concentrated in the South Umpqua Basin where, aside from Roseburg and Myrtle Creek, existing supplies will not meet projected demands.

5. Diversionary uses of stream waters in the Umpqua Basin, in addition to M&I water supply, are irrigation, mining, and power generation. Instream uses are the anadromous fishery, resident fishery, water-contact and streamside recreation. The South Umpqua has an annual escapement of about 10,000 salmon and steelhead--less than half the anadromous fish population of the North Umpqua. Recreational use is intense, particularly on the stretch of the South Umpqua that meanders through the Roseburg area.

6. Municipal and industrial waste sources in the Umpqua Basin are spread throughout the South Umpqua region and the Roseburg area. Total raw waste production in South Umpqua subbasin in 1965 was about 37,000 population equivalents (PE), with over 85 percent of the total produced in the Roseburg area. After treatment, these wastes were discharged to streams of the basin with a total oxygen demand of 5,900 PE, a reduction in bio-chemical oxygen demand (BOD) of about 84 percent.

After adequate treatment--which, for design purposes, was selected to be at least 85 percent reduction of BOD--future waste loads are expected to increase to a maximum of about 41,500 PE by the year 2000. Increased treatment efficiencies to about 90 percent BOD removal are expected to maintain this level through 2020.

B. CONCLUSIONS

1. Municipal and industrial water demands will exceed the reliable supply at varying times and places throughout the study period. By the end of the study period, an annual draft-on-storage[1/] from proposed Tiller or Galesville Reservoir of 2,350 acre-feet to yield 7.65 mgd of supplemental supply (July-September) will be required to meet the 46 mgd demand. About 55 percent of the demand will be in the Roseburg service area where the North Umpqua supply is expected to meet the demand. First need for storage will begin about the time of assumed project completion (1975).

2. The annual value of storage in Tiller or Galesville Reservoir for M&I water supply is estimated to be $220,900, based on least-cost single-purpose alternative storage costs amortized on a 50-year basis at 3.125 percent interest.

3. Minimum DO concentrations of 7 mg/l must be maintained the year around in the South Umpqua to protect and enhance the existing anadromous fish runs. With control of temperature (see FIGURE VIII-3), as recommended by the fishery agencies, fish will be migrating, feeding, and spawning in most reaches of the river throughout the year. With temperature control, anadromous fish production is expected to be more than four times present production.

4. Water quality during low flow periods does not now meet the above objectives for the South Umpqua River. Computations utilizing present and projected waste loadings show that by 2000 DO levels may be expected to drop below 3 mg/l in the months of August and September, even after wastes have received adequate treatment.

5. There is an immediate need for an annual draft-on-storage from Tiller or Galesville Reservoirs of 16,000 acre-feet to provide a minimum average flow of 190 cfs for control of DO in the months of July, August, September and October. After adequate treatment of all wastes, a draft-on-storage of 31,000 acre-feet will be needed to deliver a minimum flow in South Umpqua below Roseburg of 340 cfs for this control through the same four critical months by the year 2000. Waste loads after 2000 are expected

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1/ Annual draft-on-storage is the sum of incremental excesses of needed releases over inflows during a climatic year (April to April).

to remain fairly constant, due to increased treatment efficiency; therefore, no additional storage requirements are anticipated through 2020.

6. Temperature enhancement can be accomplished in the South Umpqua with flows from the Tiller project. To meet fishery requirements, flow releases from Tiller Reservoir ranging from 1,200 to 1,400 cfs would be required to maintain temperatures of less than 70°F.

7. Storage releases from Tiller or Galesville Reservoirs for water quality control would benefit a potential population of 120,000 persons residing along 50-60 miles of South Umpqua River and would maintain conditions suitable for fishing and other recreational uses of the river. With control of DO, annual anadromous fish spawning can be maintained in numbers upward of 10,000. Releases for temperature control would increase these numbers to an estimated 46,000 annually.

8. The benefits derived from flow regulation for water quality control in the South Umpqua River are both tangible and intangible and would accrue after an adequate degree of waste treatment has been provided at all major waste sources. The riparian owners, downstream water users, and the population of the surrounding area would be the major recipients of the benefits of this control. As beneficiaries are widespread throughout Umpqua River Basin and the State of Oregon, the cost to provide quality control regulation in Tiller or Galesville Reservoirs would be non-reimbursable.

9. The cost of providing flow regulation on a single-purpose basis is considered to be a reasonable measure of the value of the widespread quality control benefits. Based on least-cost single-purpose storage costs in South Umpqua Basin, the minimum value of the benefit assignable to an annual draft-on-storage of 51,000 acre-feet in Tiller and/or Galesville Reservoirs is $640,000 or about $12.50 per acre-foot.

10. The value of the water quality benefit associated with storage releases for temperature control and flow stabilization is considered equal to the value of the enhanced anadromous fishery. This value will be calculated by the U. S. Fish and Wildlife Service.

11. After the project is in operation, a system of water quality and waste monitoring and stream flow forecasting will be needed to effectively regulate flow for water quality control.

III. PROJECT DESCRIPTION

A. LOCATION

The Umpqua River Basin, located in southwestern Oregon, drains an area of 4,560 square miles. The major drainage feature of the basin is the main stem of the Umpqua River, which extends 111 miles inland from the Pacific Ocean to the junction of its North and South Forks. The North Umpqua extends an additional 105 miles to its headwaters in the Cascade Mountains; the South Umpqua meanders through the densely populated Roseburg area and extends some 104 miles to the Rogue-Umpqua divide.

The proposed Tiller and Galesville project sites are located in the South Umpqua drainage, as shown on the foldout location map (inside back cover). The Tiller Reservoir site is located near the town of Tiller on the South Umpqua at River Mile 75. Drainage area at the site is about 450 square miles. The Galesville site is located on Cow Creek, a tributary of the South Umpqua, near Azalea at River Mile 60. Drainage area of the reservoir is some 76 square miles.

B. PROPOSED PROJECTS

Project purposes include irrigation, flood control, municipal and industrial water supply, water quality control, fishery enhancement, recreation, and power generation.

As proposed by the U. S. Army Corps of Engineers, the Tiller and Galesville projects will have storage capacities of 545,000 acre-feet and 71,000 acre-feet, respectively, about 11 percent of the Umpqua Basin's 5.4 million acre-feet annual yield. With this storage, one-in-ten low flows of 80 cfs in the South Umpqua could be increased to over 1,000 cfs; low flows in the main stem Umpqua could be augmented from 730 cfs to almost two thousand cfs. As discussed in succeeding chapters of this report, such increases in flow will directly benefit water quality in those streams.

PACIFIC OCEAN
N
ROSEBURG
SOUTH
PROPOSED PROJECTS
LOCATION MAP

IV. STUDY AREA DESCRIPTION

A. BOUNDARIES

The study area for this report is the Umpqua River Basin; the boundaries of the basin are nearly coincidental with the boundaries of Douglas County. (See location map.)

Study emphasis has been placed on the South Umpqua River drainage and on the main stem of the Umpqua River, since these areas can be served by the proposed projects, and since they contain about 70 percent of the study area population.

B. PHYSICAL FEATURES AND CLIMATE

Topographically, the basin is composed of three definable segments: the coastal range, the central valley, which includes the South Umpqua Valley, and the Cascades. Most of the basin is forested (89 percent), with agricultural and other non-forest areas limited to the valleys of the main tributary streams. There is a total of some 650,000 acres of farm land, with 150,000 acres in crops; about 12,000 acres are irrigated.

The climate is generally mild, with warm, dry summers and cool, wet winters. There is little snow, except in the high Cascades. Precipitation ranges from an annual total of 28 inches at Riddle to over 100 inches along the crest of the Coast Range of mountains. Average length of the growing season is about 200 days in the central valley.

V. WATER RESOURCES of the Study Area

A. SURFACE WATER

1. Water Resource Development

Existing water resources development in the Umpqua Basin is not extensive, consisting primarily of several hydro-power structures in the headwaters of the North Umpqua. There are no large impoundments on the South Umpqua River, Cow Creek, or Calapooya Creek. Irrigation and water supply developments consist of pumping stations, with few diversion or ponding structures.

A total of 400,000 acre-feet of surface water rights has been allocated in the basin; over 82 percent of this is for hydro-electric power and other non-consumptive uses.

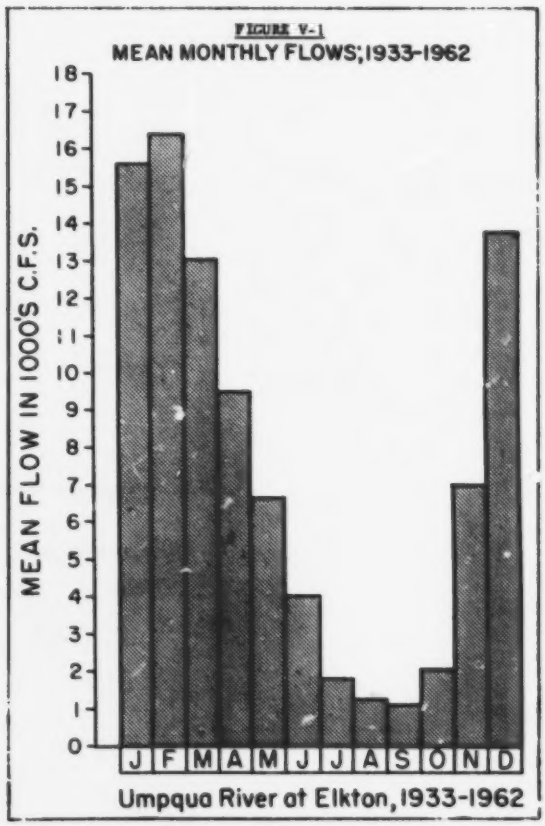
2. Hydrology

The hydrology of the pertinent streams in the Umpqua system is summarized in TABLE V-1. Figures are based on water records from 1933 to 1962.

TABLE V-1
UMPQUA RIVER BASIN HYDROLOGIC SUMMARY

Stream	Ann. Aver. Yield Million ac-ft.	Ann. Mean Flow cfs	Max. Flow of Record cfs	Min. Flow of Record cfs	1/10 Low Flow cfs
Umpqua River at Elkton	5.4	7,600	218,000	640	729
S. Umpqua at Brockway	2.1	3,000	102,000	36	79
Cow Creek nr. Riddle	0.7	820	38,000	20	20

The Umpqua system is characterized by high winter flows and summer droughts. Over eighty percent of the total annual yield occurs from November 1 to May 1, as illustrated by the hydrograph



of the Umpqua River at Elkton (FIGURE V-1). The critical months for maintaining adequate flows are July, August, September, and October.

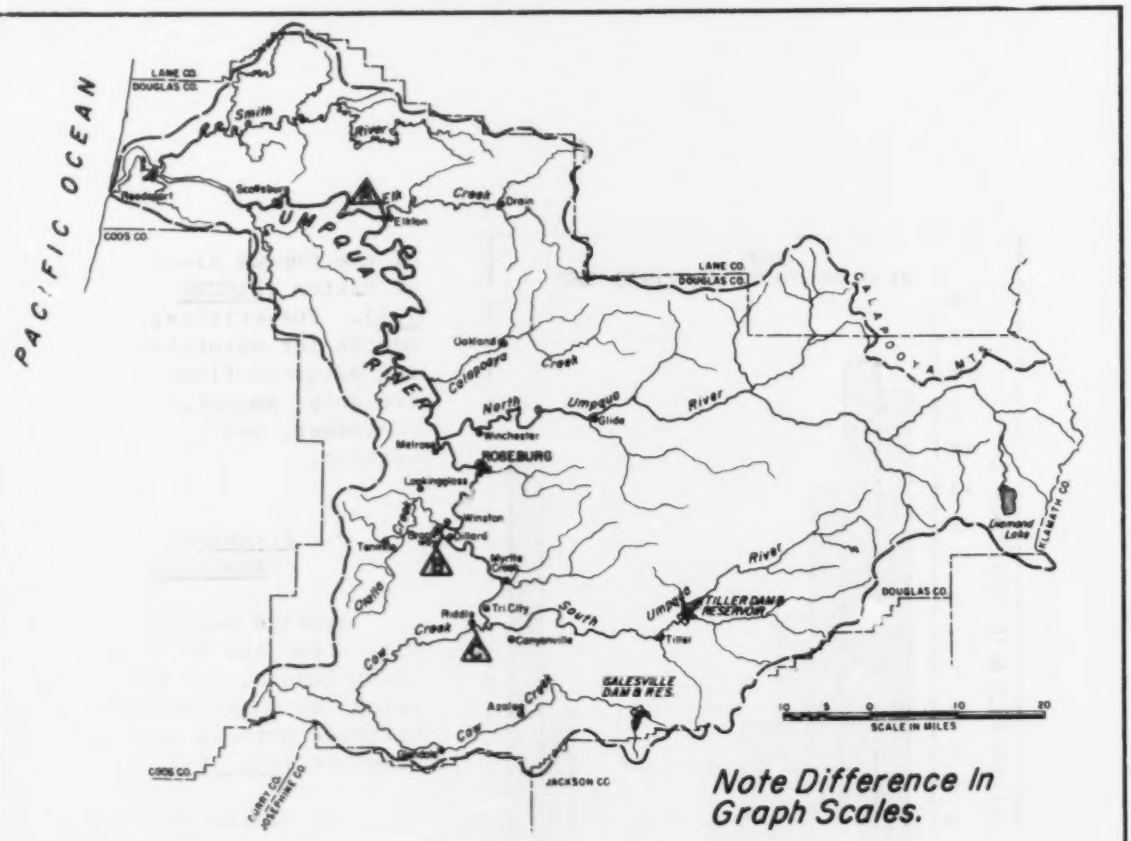
3. Frequency Analysis

Average annual yields for the Umpqua, South Umpqua, and Cow Creek for various recurrence periods are shown in TABLE V-2.

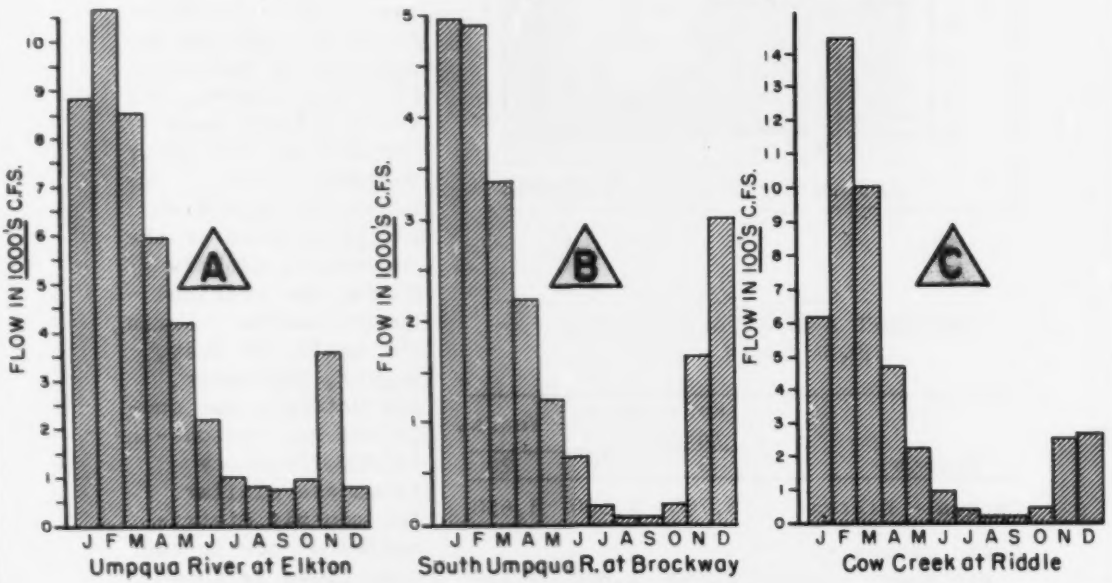
For design purposes, the one-in-ten recurrence period was selected to determine flow requirements and the resultant need for storage for water quality control. The basis for selection was protection of the anadromous fishery during the critical summer months. During the months of July, August, September, and October, the one-in-ten and the one-in-twenty frequency flows are similar. The monthly distribution of one-in-ten year flows is shown in FIGURE V-2 (following page).

TABLE V-2
EXPECTED AVERAGE ANNUAL YIELD
UMPQUA BASIN - CFS

Stream	Recurrence Interval - Years 5	10	20
Umpqua - Elkton	5,700	4,500	3,650
South Umpqua - Brockway	2,300	1,880	1,530
Cow Creek - Riddle	550	400	300



Note Difference In Graph Scales.


FLOW IN 1000'S C.F.S.
A
J F M A M J J A S O N D
Umpqua River at Elkton
FLOW IN 1000'S C.F.S.
B
J F M A M J J A S O N D
South Umpqua R. at Brockway
FLOW IN 100'S C.F.S.
C
J F M A M J J A S O N D
Cow Creek at Riddle

WATER SUPPLY & WATER QUALITY CONTROL STUDY
UMPQUA RIVER BASIN, OREGON

ONE IN TEN YEAR LOW FLOW RECURRENCES

UNITED STATES DEPARTMENT OF THE INTERIOR
Federal Water Pollution Control Administration
REGION IX (DATE: 6/66) PORTLAND, OREGON

FIGURE V-2

4. Present Water Quality

The following table summarizes available data from the files of the Oregon State Sanitary Authority, U. S. Geological Survey, and the Federal Water Pollution Control Administration by presenting the ranges of several key water quality parameters for the critical summer months of July through September. Additional water quality data is appended.

TABLE V-3
WATER QUALITY SUMMARY
UMPQUA RIVER BASIN

Stream	DO mg/l	BOD_5 mg/l	Temp. °F	Coliform Bact. MPN/100 ml
Umpqua	8.6-9.7	1.1-2.2	82-51	400-2,000
South Umpqua	6.2-12.1	0.0-2.5	94-51	10-13,000
Cow Creek	7.3-9.5	0.8-1.2	85-55	10-800

As indicated, organic waste assimilation requirements are not high enough to cause severe dissolved oxygen (DO) depression. DO levels in the South Umpqua frequently drop below 7 mg/l, but concentrations below 6 mg/l are uncommon, except during extreme low flows, when values below 5 mg/l have been observed.

Temperature is a severe water quality problem in the Umpqua system, particularly in the South Umpqua drainage. Temperatures in the South Umpqua and Cow Creek during the months of July and August average about 75°F, well above the maximum temperatures recommended for anadromous fish. Maximums have reached 98°F. Temperatures in the main stem Umpqua average about 70°F.

Bacterial contamination resulting from discharge of inadequately disinfected sewage and from land drainage is evident. The most severe problems occur in the South Umpqua as it passes through the Roseburg area.

As indicated in the appended data, ranges of pH, hardness, and total dissolved solids are well within the limits for any raw water use anticipated in the basin. High sediment concentrations from soil erosion are a seasonal phenomenon associated with periods of high surface runoff and stream flow.

5. Water Quality of Projected Storage Releases

Steep slopes with sediment production ratings at 150-500 mg/l of particulate matter cause inflows into both Tiller and Galesville Reservoirs to be turbid and fairly high in nutrients. During periods of heavy logging, organic matter and nutrients are higher.

According to estimates made by the Oregon Water Resources Board (OWRB), mass average reservoir temperatures will be highest in September. Stratification will occur in both reservoirs with September bottom-to-surface temperatures ranging from 44 to 67°F in Tiller and from 53 to 74°F in Galesville.

Based on probable nutrient levels and temperature characteristics, it is reasonable to assume that both reservoirs will experience heavy algal blooms. These blooms, together with other settling organics, could eventually cause depletions of DO at lower levels, due to decay of organic matter and lack of reaeration. For this reason, multiple level outlets should be provided to permit control of DO in reaches immediately below these structures.

B. GROUNDWATER

Little information is available on groundwater hydrology in the Umpqua River Basin. The North Umpqua River has extensive areas of volcanic pumice, which act as reservoirs, soaking up large quantities of moisture during the wet season and releasing it throughout the dry summer months. The relatively high base flow of the North Umpqua River reflects these conditions. Primarily clay-type soils are found throughout the remaining areas of the Umpqua Basin; although clay soils are capable of holding more water than pumice, the water moves into, through, and out of the clay very slowly. Most winter precipitation runs off as surface flow, and little water is released during the summer.

Only the Milo Academy relies on groundwater for a community water supply in the South Umpqua River Basin. A few industries have developed well supplies, but quantities pumped are small.

VI. THE ECONOMY

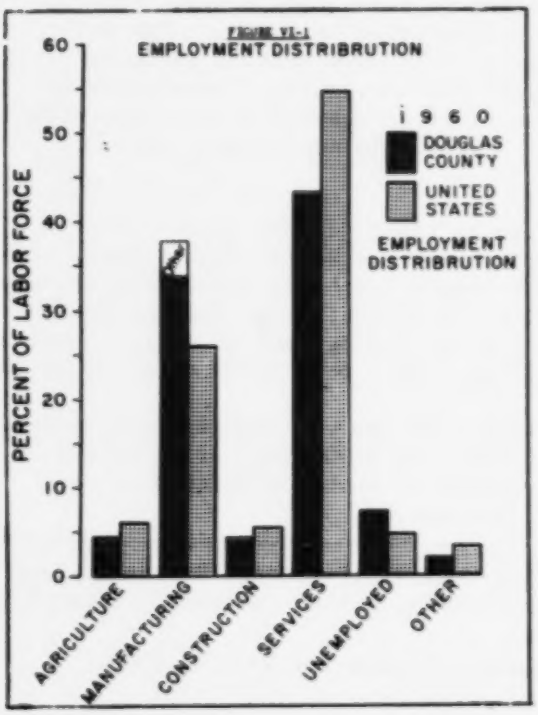
A. GENERAL

The demand for water for municipal and industrial purposes, and the amount and character of waste waters resulting from such uses, are determined largely by the activities associated with a region's economic base. The purpose of this section is to present economic and demographic data to be used as a basis for projecting the needs for water for municipal and industrial purposes and for estimating the future amounts and types of waste and land drainage material that may be expected to occur in the Umpqua River Basin with the expanded development anticipated in the future.

B. PRESENT

1. Industry and Employment

The economy of Douglas County is very heavily dependent on harvesting and processing the county's timber resource as shown in FIGURE VI-1. About 91 percent of all manufacturing employment in the county in 1960 was in lumber and wood products. Agricultural employment is relatively less important in Douglas County than in either the State or Nation as a whole. Aside from timber harvesting and processing, mining is the only other major industry sector in which Douglas County employment equals or exceeds the national average. The 234 persons employed in mining in April 1960 represented about the same percentage of total employment in Douglas County as that industry represented in the United States as a whole.



The U. S. Veterans' Hospital at Roseburg and tourism and recreation activities provide some employment in service industries; but, even so, total employment in service industries is well below the proportion in the State and Nation. This is due to the fact that Douglas County is within an area for which Portland and Eugene provide numerous services, such as trade, education, and finance.

2. Population

The total labor force of 24,289 in Douglas County in April 1960 supported a population of 68,458; that is, the ratio of population to labor force was 2.8 to 1. TABLE VI-1 shows the allocation of county population among the incorporated places and non-urban portions of the county. A large part of the population is concentrated in the narrow valleys near the junction of the North and South Umpqua Rivers. About 31,000 persons (45 percent of county total) live within a radius of ten miles from the center of Roseburg.[1/] Another 10,000 live in other towns along the main highway and railroad bisecting the county from north to south, and most of the remaining population is along this central artery, outside incorporated places but suburban in nature. The only significant population center outside this central strip is Reedsport, located on the Umpqua estuary, with a population of about 3,000. Most of the county is very sparsely settled, with large areas of virtually uninhabited and mountainous national forest land.

About 45,000 persons (two-thirds of county total) live in the portion of the county drained by the South Umpqua River. The North Umpqua subbasin is more rugged and has a population of only about 8,000. The main stem of the Umpqua, below the confluence of the North and South Forks and including such minor tributaries as Elk Creek and Calapooya Creek, has a population of about 16,000.

According to the most recent estimate,[2/] Douglas County population increased less than 2,000 from 1960-1964, or about 2.6 percent, compared with an increase of nearly 8 percent for the State as a whole during the same period.

1/ This includes the following Census Divisions: Roseburg, East Roseburg, Lookingglass, Riverdale, Wilbur, Winchester, and a portion of Melrose.

2/ Oregon State Board of Census estimate for July 1, 1964.

TABLE VI-1
POPULATION, BY SERVICE AREAS AND INCORPORATED PLACES
DOUGLAS COUNTY, APRIL, 1960

City or Area	Population April 1, 1960
Douglas County (Umpqua River Basin), TOTAL	68,458
Reedsport-Gardiner Service Area	5,246
Reedsport City	2,998
Unincorporated Portion	2,248
Roseburg Service Area	35,100
Myrtle Creek City	2,231
Oakland City	856
Roseburg Urban Area, Total	16,543
Roseburg City	11,467
"Barnes" (densely-developed suburb)	5,076
Sutherlin City	2,452
Winston City	2,395
Unincorporated Portion	10,623
Remainder of County	27,976
Drain City	1,052
Elkton City	146
Glendale City	748
Riddle City	992
Yoncalla City	698
Canyonville City	1,089
Unincorporated Portion	23,387

C. FACTORS INFLUENCING FUTURE GROWTH

The outlook for growth of the Douglas County economy depends on possibilities for (1) maintaining or increasing the annual timber harvest and (2) diversifying the economy, either by further fabrication or greater utilization of the timber harvest, or by development of new types of resources. It is assumed that the log cut in Douglas County will decline during the study period to about 80 percent of the present level. A redistribution of the use of the resource is expected, with smaller sawmills disappearing as a result of competitive pressures and output at the larger sawmills declining. This will be accompanied by an increase in output at plywood mills. However, due to increasing productivity per worker per hour, employment in lumber and wood products is expected to decline in the future. Therefore, expansion of the economy will have to come from diversification.

Raw materials are available within Douglas County to support additional pulp and paper manufacture. The possibility of the establishment of a new mill at the confluence of the North and South Umpqua Rivers by 1980 has been considered, but planned expansion of existing facilities at Gardiner, Coos Bay, Toledo, and Springfield should take up the available resource. It is assumed, therefore, that no new pulp and paper operations will be built in the Umpqua Basin within the planning period.

Other resources exist, but they do not appear to have a potential for providing large employment. Employment in mining is expected to remain at about its present level and to continue to occur primarily in the Riddle area. Increased irrigated acreage is expected to support a moderate-sized food-processing industry, located in the Roseburg area, by 1980. Although food-processing expansion is not expected to provide for large employment in the future, it will be a major contributor to future waste loads. By 1980, food-processing capacity in the South Umpqua is projected to increase by about 300 tons per day; further expansion to about 600 tons per day may be expected by 2020.

A moderate-sized meat-processing plant may also be located in the Roseburg area by 1980. Sheep grazing presently provides a raw material, but it seems probable that most of the animals will continue to go to established packing plants outside the county. Employment in service industries is expected to increase due to tourist and recreational development.

D. FUTURE

1. Projected Employment

On the basis of preceding considerations, a projection of future employment by major industry group in Douglas County is given in TABLE VI-2.

TABLE VI-2
PROJECTED FUTURE EMPLOYMENT, BY MAJOR INDUSTRY
DOUGLAS COUNTY, 1980, 2000, 2020

Industry Group	Employment, nearest thousand		
	1980	2000	2020
Agriculture	1.0	1.0	1.0
Forest Management & Fisheries	0.3	0.4	0.5
Mining	0.3	0.3	0.3
Manufacturing, TOTAL	9.9	10.9	11.5
Logging, Lumber, Wood Products	8.3	8.2	8.1
Primary Metals	0.2	0.3	0.3
All Other Durables	0.3	0.5	0.6
Food & Kindred	0.4	0.8	1.1
Printing, Publishing & Allied	0.3	0.4	0.5
All Other Non-Durables & Misc.	0.4	0.7	0.9
Construction	1.5	1.8	2.3
Services	14.7	20.1	27.3
Military	0.1	0.2	0.3
Unemployed	1.5	1.8	2.3
TOTAL LABOR FORCE	29.3	34.5	45.5

2. Projected Population

The projected labor force, as illustrated, would support a total county population of 85,000 in 1980, 106,000 in 2000, and 132,000 in 2020, based upon a labor-force-to-population ratio similar to the existing one. The allocation of this projected

future total county population to the cities and service areas within the county, while highly arbitrary, is required for planning purposes. A projected allocation is shown in TABLE VI-3. It is based upon the assumption that population in the rural portions of the county will remain at about the present level or decrease slightly, that population in the smaller incorporated places will increase at the average for the county, and that the remainder and largest part of the projected population increase would accrue to the larger cities, particularly Roseburg.

TABLE VI-3
PROJECTED POPULATION, BY SERVICE AREAS & INCORPORATED PLACES
DOUGLAS COUNTY, 1980, 2000, 2020

City or Area	Population, nearest thousand 1980	2000	2020
Douglas County, TOTAL	85.0	106.0	132.0
Reedsport Service Area	7.7	9.9	12.0
Reedsport City	5.5	7.7	9.8
Rural portion	2.2	2.2	2.2
Roseburg Service Area	48.0	66.0	90.0
Myrtle Creek City	3.4	4.9	6.8
Oakland City	1.3	1.9	2.6
Roseburg Urban Area	25.0	37.6	54.9
Sutherlin City	3.7	5.4	7.5
Winston City	3.6	5.2	7.2
Rural portion	11.0	11.0	11.0
Remainder of County	29.3	30.1	30.0
Drain City	1.3	1.6	2.0
Elkton City	0.2	0.2	0.3
Glendale City	0.9	1.1	1.4
Yoncalla City	0.8	1.1	1.4
Canyonville City	1.6	2.3	3.2
Riddle City	1.5	2.2	3.1
Rural portion	23.0	21.6	18.6

VII. WATER REQUIREMENTS
Municipal & Industrial

A. PRESENT WATER USE

The majority of the Umpqua River Basin's municipal and industrial (M&I) water needs are met from surface water sources. The following table summarizes the present M&I water use and sources of supply for the study area.

TABLE VII-1
PRESENT MUNICIPAL AND INDUSTRIAL WATER DEMAND

Subbasin User	Est. Popl. Served	Water Demand (MGD) Munic-ipal	Indus-trial	Total	Source
South Umpqua:					
Roberts Creek W.D.	3,000	0.24	0.06	0.30	South Umpqua
Winston-Dillard W.D.	3,000	0.19	0.06	0.25	South Umpqua
Tri-City W.D.	750	0.09	--	0.10	South Umpqua
Myrtle Creek W.D.	2,240	0.39	0.06	0.45	N. Myrtle Cr.
Canyonville	1,200	0.14	--	0.14	O'Shea Cr.
Roseburg	13,500	2.80	0.25	3.05	North Umpqua
Milo Academy	400	0.05	--	0.05	Groundwater
Industrial	--	--	2.96	2.96	South Umpqua
TOTAL	24,090	3.90	3.39	7.30	
Cow Creek:					
Riddle	990	0.10	0.03	0.13	Cow Cr.
Glendale	1,000	0.12	--	0.12	Cow Cr.
Industrial	--	--	3.18	3.18	Cow Cr.
TOTAL	1,990	0.22	3.21	3.43	
Calapooya Creek:					
Oakland	1,100	0.11	0.07	0.18	Calapooya Cr.
Sutherlin	2,500	0.40	0.03	0.43	Calapooya Cr.
Industrial	--	--	0.06	0.06	Calapooya Cr.
TOTAL	3,600	0.51	0.16	0.67	

B. EXISTING SOURCE DEVELOPMENT

Present demands are concentrated in the Roseburg Service Area. The City of Roseburg obtains its water from the North Umpqua, but its suburbs utilize the South Umpqua. The four separate water systems which supply the service area (Roberts Creek, Winston-Dillard, Tri-City, and Roseburg) provide chemical treatment, filtration, and disinfection because of seasonal turbidity, color and odor problems, and bacterial contamination. The major portion of industrial water used in the South Umpqua is supplied through these four systems. Other communities in the study area obtain municipal water from individual systems on the South Umpqua, Cow Creek, or Calapooya Creek. Industrial supplies on the Cow Creek have been developed by Hanna Nickel Smelting Company and Monroe Lumber Company.

C. PROJECTED M&I DEMANDS AND STORAGE REQUIREMENTS

The forecast of future demands is based on economic projections and present consumption rates for the various communities. Per capita consumption rates average 115 gpd with peak summer demands of over three times the average use. Average per capita rates are projected to increase to over 190 gpd by 2020. Future industrial demands are based on production forecasts with the heaviest users being food processing and forest products.

Study area demands for M&I water for the years 1980, 2000, and 2020 are projected to total 22.0, 28.8, and 46.0 mgd, respectively. About 55 percent of this demand will occur in the Roseburg Service Area. Industrial water demands will constitute about 60 percent of the projected M&I demand.

TABLE VII-2 shows the projected water demands and the supplemental storage requirements needed to meet these needs. Future demands for M&I water supply in the South Umpqua Basin will necessitate the most supplemental storage. Minimum natural stream flow of the South Umpqua is fully appropriated (240 cfs of consumptive rights); and, in fact, is over-appropriated during critical years. In addition, the Oregon Water Resources Board has established a minimum flow of 60 cfs at the mouth of the South Umpqua. (The minimum observed flow of record is 36 cfs.) Limited storage will be needed on Cow Creek to meet future demands.

Supplemental storage requirements for the Roseburg Service Area are based on the projections for suburban areas. The City's North Umpqua River supply is considered adequate to meet future demands for the urban area. However, consideration should be given to a South Umpqua supply to meet peak demands.

TABLE VII-2
PRESENT AND PROJECTED MUNICIPAL AND INDUSTRIAL WATER DEMAND
UMPQUA RIVER BASIN

Area and Consumer	Water Use (MGD)	Projected Water Demands (MGD)			Supplemental M&I Storage Requirements (ac-ft.)			
	Present	1980	2000	2020	Present	1980	2000	2020
South Umpqua:								
Roseburg	3.05	4.50	6.10	10.00				
Suburban Roseburg 1/	--	0.60	0.83	1.28				
Roberts Creek	0.30	0.60	0.83	1.28	5	150	260	480
Winston-Dillard	0.25	0.60	0.83	1.28	--	--	90	310
Tri-City	0.10	0.15	0.21	0.46	--	--	--	15
Myrtle Creek W.D.	0.45	0.50	0.62	0.93	--	--	--	--
Canyonville	0.14	0.30	0.41	0.68	--	45	100	230
Milo Academy	0.05	0.10	0.16	0.18	10	30	60	70
Private industry 2/	2.96	10.00	13.60	23.50	--	150	580	1,800
Cow Creek:								
Riddle	0.13	0.30	0.41	0.68	--	--	--	85
Glendale	0.12	0.15	0.21	0.46	--	--	100	125
Private industry	3.18	3.44	3.44	3.44	--	--	--	--
Calapooya Creek:								
Oakland	0.18	0.17	0.21	0.46	--	--	--	--
Sutherlin	0.43	0.50	0.83	1.28	--	--	--	5
Private industry	0.06	0.10	0.10	0.10	--	--	--	--
TOTAL	11.40	22.01	28.79	46.01	15	375	1,190	3,115

1/ This area will most probably be served from the North Umpqua River. A system study is underway currently.

2/ Pulp and paper not included.

Based on TABLE VII-2, total M&I storage needs applicable for inclusion in Tiller Reservoir are about 3,100 acre-feet. However, the Olalla Reservoir project (U. S. Bureau of Reclamation) has an appropriation of 760 acre-feet of storage for M&I water supply to supplement the Roberts Creek-Winston-Dillard supplies. When this is subtracted, a total of 2,350 acre-feet of storage is applicable for inclusion in the Tiller project. It should be noted, however, that there is no authority within the study area to contract for the storage.

VIII. WATER QUALITY CONTROL

A. NEED FOR CONTROL

Water uses requiring controlled water quality include municipal and industrial water supply, resident and anadromous fishery, and recreation. Although these uses are discussed for the entire Umpqua Basin, particular emphasis has been given to the uses on the South Umpqua and Cow Creek, which could be served by the proposed projects.

1. Municipal and Industrial

As discussed in the preceding chapter, both the existing and potential water supply sources for municipalities and industries are the surface waters of the main stem Umpqua, Cow Creek, South Umpqua, and Calapooya Creek.

2. Fishery

The Umpqua River and tributaries support extensive populations of anadromous fish, including Chinook and Coho salmon and steelhead and cutthroat trout. Resident trout also inhabit the river system. The anadromous fish, which spawn and rear in the basin, contribute to a large sport fishery along the various tributaries and in the ocean, as well as to the offshore commercial fishery. Preliminary figures from a survey conducted by Oregon State University in 1965 give some indication of intensity of the sport fishery in the basin. In that year, total effort by Oregon residents was estimated to be about 350,000 fisherman trips. The estimated sport catch was about 97,000 salmon and steelhead and over 200,000 trout. Some of the salmon caught in the ocean were probably produced in other streams. In addition to Oregon residents, fishing pressure from out-of-state tourists is increasing steadily with the completion of access roads and camping facilities.

As shown in FIGURE VIII-1, nearly every stream in the Umpqua Basin is used by anadromous fish for spawning, rearing, or migration. Present spawning population estimates for the North and South Umpqua are listed in TABLE VIII-1.

TABLE VIII-1 - PRESENT ANADROMOUS FISH SPAWNING POPULATIONS--UMPQUA RIVER BASIN

Species	North Umpqua	South Umpqua	Total
Spring Chinook	11,000	600	11,600
Fall Chinook	200	600	800
Coho	1,200	2,800	4,000
Summer Steelhead	4,800	--	4,800
Winter Steelhead	7,700	6,000	13,700
TOTAL	24,900	10,000	34,900

WATER SUPPLY & WATER QUALITY CONTROL STUDY
UMPQUA RIVER BASIN, OREGON

ANADROMOUS FISH SPAWNING AREAS

UNITED STATES DEPARTMENT OF THE INTERIOR
Federal Water Pollution Control Administration
REGION IX (DATE: 6/66) PORTLAND, OREGON

FIGURE VIII-1

Although both streams still have extensive fishery today, there has been a deterioration of the stream environment in the basin, and particularly in the South Umpqua, which has reduced fish populations. The Oregon State Game Commission estimates that runs have been reduced by over 70 percent from historic populations. A considerable portion of this reduction can be attributed to degradation of the South Umpqua.

Anadromous fish activities in the South Umpqua are illustrated in FIGURE VIII-2. In general, summer and fall temperatures and stream flows in the lower South Umpqua are undesirable for salmonid species which are using the stream at that time. Low summer stream flows and high water temperatures restrict the rearing potential in the South Umpqua and delay fall Chinook and Coho from entering the river to spawn. Summer steelhead are not present in the stream for the same reasons.

FIGURE VIII- 2
ANADROMOUS FISH ACTIVITIES IN SOUTH UMPQUA RIVER

ACTIVITY	J F M A M J J A S O N D	LOCATION	QUALITY REQM'T D.O.	QUALITY REQM'T TEMP. °F
Adults Upstream	SCh; FCh; WSt; WSt; Coho; Coho; SSt	Mainstem and Tribs	7	43-55
Holding	SCh; FCh; SSt; WSt; WSt; Coho	Upper MS Lower MS	7	50-65
Spawning and Incubation	SCh; FCh; Coho; SAWSt; SCh; FCh; Coho	Upper MS Lower MS Tribs.	7	43-55
Juveniles in Streams	SCh Coho SSt WSt	Mainstem and Tribs	7	43-67
Fingerlings Downstream	SCh FCh Coho SSt WSt; SCh WSt SSt	Mainstem and Tribs	7	45-65

Species Legend. SCh - Spring Chinook; FCh - Fall Chinook;
SSt - Spring Steelhead; WSt - Winter Steelhead; Coho - Coho.

With higher flows and resultant lower temperatures, the early segments of Chinook and Coho salmon runs would migrate and spawn about one month earlier, and the lower river could be used more extensively for spawning and rearing. With this stream regimen, the lower Umpqua River could be used much more extensively for spawning and rearing.

The present salmonid fishery and projected future populations with the Tiller project are shown in TABLE VIII-2.

TABLE VIII-2
PRESENT AND PROJECTED SALMONID FISH POPULATIONS

	Present	Projected with Tiller Project
Spring Chinook	600	7,400
Fall Chinook	600	21,000
Coho	2,800	3,000
Winter Steelhead	6,000	9,300
Summer Steelhead	--	5,000

3. Recreation

Recreational use of the Umpqua Basin streams is intense, a function of established recreational habits. Other than game fishing, recreational water uses include boating, water-contact sports, picnicking, and camping. Since each stream has many points of access, user statistics to show intensity of demand are only partially available. However, an impressive rise in the number of visits to State parks in the basin indicates a trend in water-oriented recreation. Day visits to all State parks have doubled between 1960 and 1965. Parks providing water activities show even more spectacular attendance growth.

In addition to State facilities, the South Umpqua is extensively used by Roseburg residents for picnicking, swimming and other water-contact recreation. Although several city parks are located on the lower South Umpqua, the stream is not aesthetically appealing during summer low flow periods. A combination of low flow, high temperatures, profuse algal growths, and floating solids damage the recreation potential of the stream.

B. WASTE LOADS

1. Municipal and Industrial

Because of the importance of dissolved oxygen content of water, both as a measure of pollution and as a requirement for fish life, municipal and industrial waste loads are expressed in terms of their oxygen consumption--the biochemical oxygen demand (BOD). This demand is expressed in terms of population equivalents (PE) for this report.

Present municipal and industrial waste loadings for the Umpqua Basin are shown in Appendix B and summarized in TABLE VIII-3 by major loading point.

TABLE VIII-3
MUNICIPAL AND INDUSTRIAL WASTE LOADS--1965
UMPQUA RIVER BASIN

Loading Point	Raw P.E.	Discharged P.E.	Receiving Stream
Canyonville	1,200	180	S. Umpqua
Glendale	900	150	Cow Creek
Riddle	1,000	250	Cow Creek
Roseburg Area	32,350	5,100	S. Umpqua
Drain	1,100	150	Elk Creek
Remainder of Basin	525	70	
Total	37,075	5,900	

The South Umpqua receives the major portion of basin wastes, with loading points concentrated in the Roseburg area. The Roseburg service area, as defined in Chapter VI, produces over 85 percent of the total basin wastes. Although Sutherlin is currently discharging to the North Umpqua, it is considered close enough to the Roseburg area to be included for planning purposes. Wastes from the coastal communities of Reedsport and Gardiner are not included because ocean outfalls remove wastes from the sphere of influence of the Umpqua streams.

There are no major industrial wastes with separate outfalls in the basin, except for the paper mill at Gardiner which discharges to the ocean. Food processing operations discharge to municipal systems and are included in the municipal loads listed.

Total waste production of the basin, excluding the coastal communities and industries, is about 37,000 PE. All basin wastes receive treatment before discharge; over-all reduction of wastes is about 84 percent, with about 5,900 PE discharged to the watercourse.

Future waste load projections are based on the economic forecasts presented in Chapter VI. The following assumptions have been made: (1) future food processing and other industries in the Roseburg area will be connected to municipal systems: (2) additional pulp and paper expansion will be located on the coast; and (3) municipal and industrial wastes will receive at least 85 percent treatment in 1980 and 2000 and at least 90 percent treatment by 2020. From these assumptions, projected future waste loads are shown in TABLE VIII-4. It should be noted that due to assumed increases in treatment efficiency, 2020 projected loads are less than those for 2000.

TABLE VIII-4
PRESENT AND FUTURE WASTE LOADS
DISCHARGED TO UMPQUA STREAMS
(Population equivalents)

Loading Point	1965	1980	2000	2020
Canyonville	200	300	400	400
Glendale	200	200	200	200
Riddle	300	300	400	400
Roseburg Service Area[a/]	5,100	22,600	39,800	38,800
Drain	200	300	400	300
Remainder of Basin	100	200	300	200
Total	5,900	23,900	41,500	40,300

a/ Includes the communities of Myrtle Creek, Winston, Dillard, Sutherlin, Winchester, and Oakland.

Increases in municipal and industrial waste loads are anticipated to occur primarily in the Roseburg area. Not only is population growth centered in this area but large increases in food processing wastes are forecast. Food processing wastes account for the large increase in waste loads between 1965 and 1980.

C. WATER QUALITY OBJECTIVES

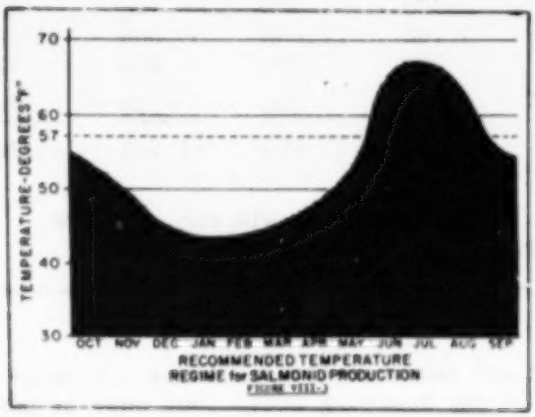
Water quality control evaluations consider primarily those water quality and water pollution control problems which can be improved or maintained by stream flow regulation. For the South Umpqua and its tributaries, these include dissolved oxygen, temperature, and nuisance aquatic growths and are associated with maintenance of fishlife, water recreation, and aesthetic environment. The benefits associated with water quality control for these uses are widespread. Water quality objectives have been developed for the various water uses based on the following indicators.

1. Dissolved Oxygen

The dissolved oxygen (DO) objective for the South Umpqua is delimited by anadromous fishery requirements--the use requiring the highest DO level. Other uses served at this level are recreation and aesthetic conditions. Since salmon and steelhead use the stream at all times of the year for either spawning, rearing, or migration, a minimum objective of no less than 7 mg/l must be maintained in the lower South Umpqua throughout the year. DO saturation is required in headwater areas for fish spawning and incubation.

2. Temperature

Temperature requirements for the South Umpqua are also governed mainly by the anadromous fishery, but recreation and general stream conditions benefit from cooler water temperatures. The following illustration (FIGURE VIII-3) shows the temperature regimen for anadromous fish production. Maximum temperatures should not exceed 70°F during July and August, to facilitate fish migration, holding and rearing; by mid-September, temperatures should not exceed 57°F to obtain optimum egg survival.



RECOMMENDED TEMPERATURE REGIME for SALMONID PRODUCTION
FIGURE VIII-3

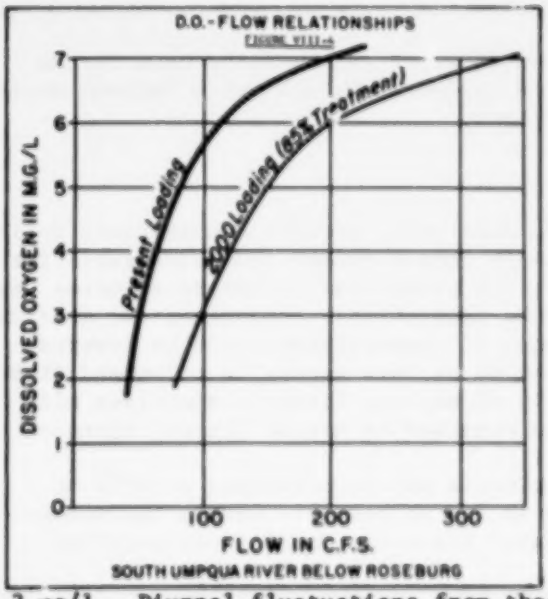
Maintenance of DO and temperature levels to protect and restore the anadromous fishery in the South Umpqua would aid in the abatement of biological nuisance problems.

3. Bacteria

Bacterial objectives for recreation and water supply use are 1,000 MPN and 5,000 MPN, respectively. Treatment, including disinfection, is required to reduce bacterial concentrations.

D. EVALUATION OF FLOW REGULATION REQUIREMENTS

Flow regulation for quality control is required in the South Umpqua River to maintain the present and future use of the stream. The maintenance and enhancement of the anadromous fishery is the critical use requiring additional flow. Controlled storage releases are needed to: (1) maintain dissolved oxygen concentrations of at least 7 mg/l during the months of July, August, September, and October and (2) lower downstream water temperatures during the same period.



1. Dissolved Oxygen

DO-flow relationships have been computed for the South Umpqua for present and projected loading conditions. Two of these curves are shown in FIGURE VIII-4. Under present loading conditions, the one-in-ten drought flows of 80 cfs in August and September would result in average DO levels of about 5 mg/l. Under projected loading conditions, the year 2000 with 85 percent treatment is the most critical. Without flow regulation, DO concentrations during the critical period would drop below 3 mg/l. Diurnal fluctuations from these values would be about 1 mg/l. Under minimum recorded daily flows (36 cfs) near-septic conditions would occur.

Flow requirements, in combination with adequate treatment, and storage requirements to meet deficiencies under one-in-ten drought conditions are shown for the four critical months in TABLE VIII-5. Reservoir releases are not needed during the rest of the year to maintain over 7 mg/l DO throughout the study period. However, it should be noted that, if future development of the basin significantly alters projected conditions, releases may be required during winter months.

TABLE VIII-5
FLOW AND STORAGE REQUIREMENTS
SOUTH UMPQUA BELOW ROSEBURG SEWAGE TREATMENT PLANT

Month	Base Flow Ave.No. 1/ cfs	Dissolved Oxygen Objective mg/l	Present		1980		2000		2020	
			Flow Req'd cfs	Storage Releases Req'd AF	Flow Req'd cfs	Storage Releases Req'd AF	Flow Req'd cfs	Storage Releases Req'd AF	Flow Req'd cfs	Storage Releases Req'd AF
July	163	7	192	1,785	240	4,740	335	10,580	327	10,100
Aug.	79	7	192	6,950	240	9,900	335	13,750	327	13,250
Sept.	79	7	192	6,830	240	9,600	335	13,250	327	14,750
Oct.	186	7	192	370	240	3,320	335	9,130	327	8,670
TOTAL				15,935		27,560		46,710		46,770

1/ Based on one in ten drought recurrence at Brockway gage.

Based on this analysis, there is an immediate need for an annual draft-on-storage 1/ of 16,000 acre-feet and a maximum study period need of 51,000 acre-feet.

2. Temperature

As shown in Chapter V, Section 4, present temperatures during the summer months in the South Umpqua exceed those desirable for the existing and potential fish production. Fishery agencies have indicated that there would be considerable enhancement of anadromous fish runs in the South Umpqua if temperatures could be lowered. Although it is beyond the scope of this agency to recommend fishery enhancement, the feasibility of meeting fishery objectives with the Tiller project has been examined to assist fishery agencies.

Fishery enhancement criteria are temperatures of 57°F or lower by mid-September and as low as possible during the summer. Examination of the State Water Resources Board study entitled

1/ Annual draft-on-storage is the sum of incremental excesses of needed releases over inflows during a climatic year (April to April).

Water Temperature Prediction and Control - Umpqua River Basin 1964 shows that the recommended temperatures could be maintained almost to the mouth of the South Umpqua in all months except September and October with releases from the Tiller project. Fall temperatures could be met by allowing higher summer temperatures (up to 72°F) at the mouth and thereby conserving colder water for fall release.

A schedule developed by the Corps of Engineers showing probable releases from the Tiller Reservoir and the associated temperature regimen for the South Umpqua is shown in TABLE VIII-6.

TABLE VIII-6
SOUTH UMPQUA RIVER
TILLER RESERVOIR - STREAM TEMPERATURE CONTROL

Month	Probable Release Rate cfs	Recommended Criteria °F*	Predicted Temperature °F At the Dam	Max. at the Mouth	Mean at the Mouth
October	612	53	52	60	57
November	350	50	46	51	48
December	350	45	39	43	41
January	350	43	40	40	40
February	350	43	40	46	44
March	350	46	40	48	46
April	525	48	45	55	53
May	858	55	51	61	58
June	1,139	65	55	68	65
July	1,471	67	55	71	67
August	1,244	62	52	67	64
September	885	56	52	66	63

*Desired temperature at midpoint from dam to mouth.

IX. BENEFITS

A. WATER SUPPLY - MUNICIPAL AND INDUSTRIAL

A future need for storage for municipal and industrial water exists in the Umpqua Basin as described in Chapter VII. By the year 2020, supplemental storage to yield 7.65 mgd or 2,350 acre-feet will be needed. First need will begin at about the time of assumed project completion (1975).

The value of this storage has been estimated by approximating the single-purpose cost that would be required to develop the needed supply in the absence of the Tiller and Galesville Projects. The most likely alternative source available is on Jackson Creek (Sec. 2, T30S, R1E). Based on this alternative, the annual value of 2,350 acre-feet of storage in the project including operation and maintenance is estimated to be $220,900, with a 50-year amortization at an interest rate of 3.125 percent.

B. WATER QUALITY CONTROL

The various uses requiring controlled water quality (fishlife, recreation, and general aesthetics) were discussed in detail in Chapter VIII, and it has been shown that the anadromous fishery requirements are the most stringent. Other uses, however, will benefit from the higher DO and reduced temperatures. Storage releases from the Tiller and Galesville Projects are needed in addition to adequate treatment to protect and maintain these uses. Failure to provide flow regulation would allow further degradation in the stream environment and cause further reduction of the South Umpqua fish population.

Beneficiaries of flow regulation for water quality control are widespread throughout the Umpqua Basin and the State of Oregon; neither the polluters who contribute to the water quality degradation nor the users who benefit from the improved quality can be specifically identified. The cost of water quality control in these projects is, therefore, non-reimbursable.

The minimum value of storage for water quality control in the South Umpqua is considered to be equal to the least-cost alternative in the absence of the Tiller Project. Waste disposal underground, transmission of wastes downstream to the main stem Umpqua, and waste lagooning are not feasible in the Umpqua Basin. The least-cost alternative would be a single-purpose reservoir located on Jackson Creek below the confluence of Luck Creek in Section 2, T30S, R1E, which could provide the required flow regulation.

Based on this alternative, the minimum value assignable to an annual draft-on-storage of 51,000 acre-feet, based on a 50-year amortization at a rate of 3.125 percent, is estimated to be $640,000.

The value of storage for fishery enhancement (temperature control and flow stabilization) is assumed to be the value of the enhanced fishery as determined by the fishery agencies concerned.

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17. Oregon Outdoor Recreation, A Study of Non-Urban Parks & Recreation;
Oregon State Highway Department, June, 1962.

APPENDIX A

Table 1

OSSA-USGS BASIC DATA AND MONITORING STATION LOCATIONS
UMPQUA RIVER BASIN

Sta. No.	Stream and River Mile	Location Description	Sampling Monthly	Data Quar.	Data Available	Sta. Mon.	Type B.D.
SU5	S Umpqua U112-48	Hwy 22 Br. at Day's Creek	x	x 1/	7-14-59 to 11-9-61		x
SU4	S Umpqua U112-45	Co. Rd. 2 mi. No. of Canyonville	x		7-14-59 to 10-17-60	x	
CC4	Cow Creek U112-41-35	½ mi. upstream from Glendale STP	x		7-15-59 to 10-17-60	x	
CC3	Cow Creek U112-41-34	½ mi. dnstream from Glendale STP	x		7-14-59 to 10-17-60	x	
CC2	Cow Creek U112-41-3	½ mi. upstream from Riddle STP	x		7-14-59 to 10-17-60	x	
CC1	Cow Creek U112-41-1	½ mi. dnstream from Riddle STP	x		7-14-59 to 10-17-60	x	
SU3	S Umpqua U112-34	US Hwy 99 Br. at Myrtle Creek	x		7-14-59 to 10-17-60	x	
SU2	S Umpqua U112-18	Old Hwy 99 Br.6 mi. S of Roseburg	x		7-14-59 to 10-17-60	x	
SU1	S Umpqua U112-8	Melrose	x	x 1/	7-14-59 to 11-9-61		x
NU3	N Umpqua U112-27	Lone Rock Br.	x	x 1/	7-14-59 to 11-9-61		x
NU2	N Umpqua U112-15	Clover Creek Br.	x		7-14-59 to 10-17-60	x	
NU1	N Umpqua U112-2	Garden Valley Br.	x		7-14-59 to 10-17-60	x	
U5	Umpqua U86	Umpqua Bridge	x		7-14-59 to 10-17-60	x	
U4	Umpqua U74	Tyee Bridge	x		7-14-59 to 10-17-60	x	
U3	Umpqua U16	Kellogg Bridge	x		7-14-59 to 10-17-60	x	
EC1	Elk Creek U43-0.1	Elkton	x		7-14-59 to 10-17-60	x	
U2	Umpqua U43	Elkton	x	x 1/	7-14-59 to 11-9-61		x
U1	Umpqua U24	Scottsburg	x		7-14-59 to 10-17-60	x	

1/ Started 2-22-61

APPENDIX A

Table 2

UMPQUA RIVER BASIN WATER QUALITY SUMMARY

		Average July-September OSSA Water Quality Analyses								Significant Basic Data Overall Averages					
				DO			Cond.	M P N		Hard. as $CaCO_3$		C o l o r		Turbidity	
Sta.	River Mile	pH	Temp (°C)	(% Sat)	BOD_5 (mg/l)	PBI (mg/l)	(µmho/ cm)	Value	Comment	(mg/l)	Comment	Units	Comment	Units	Comment
SU5	U112-48	8.3	22	110	0.4	<1	135	190 190 overall	(1)(2)	44	Soft	20 (80 max)	High	11 (74 max)	High
SU4	U112-45	8.3	23	110	0.6	<1	135	160 920 overall	(1)(5)	--	--	--	--	--	--
CC4	U112-41-35	7.4	23	102	0.5	<1	124	540 330 overall	(1)(3)	--	--	--	--	--	--
CC3	U112-41-34	7.3	23	112	0.9	<1	133	24,500 17,600 overall	(1)(4)	--	--	--	--	--	--
CC2	U112-41-3	8.1	24	113	0.4	<1	148	<260 180 overall	(1)(2)	--	--	--	--	--	--
CC1	U112-41-1	8.3	21	125	1.2	<1	150	2,180 6,700 overall	(1)(4)	--	--	--	--	--	--
SU3	U112-34	7.9	22	104	1.5	<1	150	>16,000 >7,500 overall	(1)(4)	--	--	--	--	--	--
SU2	U112-18	8.1	23	97	0.9	<1	160	560 1,320 overall	(1)(5)	--	--	--	--	--	--
SU1*	U112-8	8.0	22	105	1.7	<1	159	>4,000 >9,800 overall	(1)(4)	56	Soft to mod. hard	25 (140 max)	High	12 (58 max)	High

(1) Requires chlorination; (2) OK for all recreational purposes; (3) OK for all recreational purposes but swimming; (4) NG for all recreational purposes; (5) Questionable for recrestion.

* Basic data stations.

(Continued)

APPENDIX A

Table 2 (Continued)

Sta.	River Mile	Average July-September OSSA Water Quality Analyses								Significant Basic Data Overall Averages					
		pH	Temp (°C)	DO (% Sat)	BOD_5 (mg/l)	PBI (mg/l)	Cond. (μmho/cm)	MPN Value	MPN Comment	Hard. as $CaCO_3$ (mg/l)	Hard. Comment	Color Units	Color Comment	Turbidity Units	Turbidity Comment
NU3*	U112-27	7.7	18	103	0.6	<1	64	120 107 overall	(1)(2)	24	Soft	10 (50 max)	Quest.	9 (61 max)	High
NU2	U112-15	7.8	18	105	0.6	<1	67	83 200 overall	(1)(2)	--	--	--	--	--	--
NU1	U112-2	7.8	20	98	0.4	<1	68	<140 <170 overall	(1)(2)	--	--	--	--	--	--
U5	U86	7.9	21	97	0.4	<1	78	<170 410 overall**	(1)(2)	--	--	--	--	--	--
U4	U74	8.1	22	102	0.4	<1	76	150 850 overall**	(1)(2)	--	--	--	--	--	--
U3	U61	8.2	22	105	0.5	<1	78	90 1200 overall**	(1)(2)	--	--	--	--	--	--
EC1	U43-0.1	8.1[a]	23[b]	109[c]	1.8[d]	<1	127	110 205 overall**	(1)(2)	--	--	--	--	--	--
U2*	U43	8.2[e]	23[f]	112	2.2[g]	<1	78	120 990 overall**	(1)(2)	32	Soft	24 (140 max)	High	17 (85 max)	High
U1	U24	8.0	23	107	0.5	<1	78	260 760 overall**	(1)(3)	--	--	--	--	--	--

(1) Requires chlorination; (2) OK for all recreational purposes; (3) OK for all recreational purposes but swimming; (4) NG for all recreational purposes; (5) Questionable for recreation.

a/ 9.4 max., 7-18-60. b/ 28 max., 7-18-60). c/ 72 min., 8-11-59. d/ >6.5 max., 8-11-59. e/ 9.1 max., 7-18, 8-15-60. f/ 27 max., 7-18-60. g/ >9.0 max., 9-9-59.

* Basic data station.

**High counts during spring months.

APPENDIX B

PHS Water Quality Survey
Umpqua River Basin
August 18-21, 1963

Sampling Station Locations

No.	Location	Remarks
COW-1	Cow Creek near mouth	Sample from new bridge.
COW-2	Cow Creek above Riddle	Sample at USGS gage.
COW-3	Cow Creek near Azalea	Sample underneath bridge on Grants Pass Highway (99) near Quinos Cr.
COW-Spec	Cow Creek at Riddle Water Intake	Sample from new bridge.
SU-5	S. Umpqua above Milo	1 mile upstream of Milo Academy at Corn Creek Road.
SU-4	S. Umpqua at Riddle Bridge	
SU-3	S. Umpqua at Dillard Bridge	
SU-2	S. Umpqua at VA Hospital	Veterans Admin. Hosp. Bridge
SU-1	S. Umpqua at mouth	Sample from boat float at County Park.
NU-2	N. Umpqua at Lone Rock Br.	Bridge east of Glide.
NU-1	N. Umpqua at mouth	County Park.
NU-Spec	N. Umpqua at Winchester Dam	
CAL-2	Calapooya at Oakland	Water intake.
CAL-1	Calapooya at Umpqua	Sample from bridge ½ mile upstream from mouth.
CAL-Spec	Calapooya near Nonpareil	Sutherlin water intake.
EC-2	Elk Creek near Drain	Sample from bridge.
EC-1	Elk Creek at Elkton	Sample from bridge.
UR-2	Elk Creek at Umpqua	Sample from bridge.
UR-1	Elk Creek at Elkton	Sample from bridge.

APPENDIX B

PHS Water Quality Survey
Umpqua River Basin
Bacteriological Data
8/20-22/63

Sample 1/	Total Coliforms*		Fecal Coliforms*	
	Midnight	Noon	Midnight	Noon
COW-1	200	110	20	24
COW-2	800	<10	10	<2
COW-3	200	60	<10	12
SU-4	1,300	60	50	<2
SU-5	<100	10	<10	<2
COW Special		20		2
SU-1	7,000	700	120	100
SU-2	700	390	360	210
SU-3	13,000	490	240	176
NU-1	180	80	90	60
NU-2	220	80	12	4
NU Special		150		<2
CAL-1	1,800	2,300	14	310
CAL-2	200	620	16	520
EC-1	240	1,000	22	270
EC-2	16,000	7,200	2,900	6,400
UR-1	2,000	1,500	24	24
UR-2	490	410	28	144
CAL Special		3,200		1,000
Southerland Special		630		190

* Count/100 ml.
1/ List of sampling stations shown in Table 13-7.

APPENDIX B

STREAM DISCHARGE DATA, UMPQUA RIVER BASIN
PHS Water Quality Survey - August, 1963

Gaging Station	Date of Discharge (cfs)								
	15	16	17	18	19	20	21	22	23
Jackson Creek near Tiller	23	23	22	22	22	21	21	21	21
South Umpqua River at Tiller	75	72	70	68	68	66	66	66	66
Cow Creek near Azalea . .	15	15	15	15	14	14	14	15	15
Cow Creek near Riddle . .	55	55	52	50	50	50	52	52	52
South Umpqua River near Brockway	143	141	139	135	133	130	126	126	130
North Umpqua River at Winchester	940	913	868	814	832	877	886	895	868
Calapooya Creek near Oakland.	16	15	14	14	14	12	11	9.8	12
Umpqua River near Elkton.	1110	1160	1130	1120	1090	1080	1080	1090	1090
Elk Creek near Drain. . .	3.4	3.4	3.0	3.0	2.6	2.6	1.8	1.4	1.8

APPENDIX B

PHS WATER QUALITY SURVEY, UMPQUA RIVER BASIN
August 18-21, 1963

Date	Time	Station	Temp. °C	pH	Milligrams per liter (mg/l) DO	BOD_5	Hardness	Sol. PO_4	Total Solids	Cl	B
8/18/63	2330	COW-1	22	8.26	8.5	0.9	63	0.10	110	8.0	---
8/19/63	0655	COW-1	20	8.08	7.7	0.8	62	0.08	---	8.1	---
8/19/63	1205	COW-1	21	8.39	9.0	1.1	--	--	130	---	---
8/19/63	1735	COW-1	22	8.50	9.5	1.2	--	0.04	---	---	---
AVERAGE.			21	8.31	8.7	1.0	62	0.07	120	8.0	
8/19/63	0015	COW-2	20	8.00	7.9	1.0	65	nil	112	7.6	---
8/19/63	0710	COW-2	18	7.90	8.1	0.6	67	nil	---	7.6	---
8/19/63	1245	COW-2	21	8.44	9.5	0.9	--	---	118	---	---
8/19/63	1750	COW-2	22	8.45	9.4	0.8	--	0.03	---	---	---
AVERAGE.			20	8.20	8.7	0.8	66	0.01	115	7.6	
8/18/63	2145	COW-3	19	7.42	7.3	1.0	55	0.08	100	3.0	---
8/19/63	0450	COW-3	15	7.42	7.7	0.5	56	0.03	---	2.7	---
8/19/63	1030	COW-3	18	7.74	8.9	0.8	--	----	104	---	---
8/19/63	1555	COW-3	22	7.61	8.5	1.2	--	0.04	---	---	---
AVERAGE.			18	7.55	8.1	0.9	56	0.05	102	2.8	
8/19/63	1125	COW Spec.	21	8.38	9.4	0.9	62	0.05	102	---	Trace*
8/19/63	0045	SU-4	20	8.00	7.9	0.9	58	0.02	130	7.5	Trace*
8/19/63	0730	SU-4	20	8.08	8.0	0.5	59	0.08	---	7.7	---
8/19/63	1315	SU-4	22	8.92	9.9	1.2	--	----	120	---	---
8/19/63	1805	SU-4	23	8.74	9.5	0.0	--	0.06	---	---	---
AVERAGE.			21	8.44	8.8	0.6	58	0.05	125	7.6	

(continued)

PHS WATER QUALITY SURVEY, UMPQUA RIVER BASIN (continued)

Date	Time	Station	Temp. °C	pH	Milligrams per Liter (mg/l) DO	BOD_5	Hardness	Sol. PO_4	Total Solids	Cl	B
8/18/63	2240	SU-5	20	8.18	8.1	0.9	50	0.03	110	7.7	---
8/19/63	0545	SU-5	20	7.78	7.9	1.0	50	nil	---	7.6	---
8/19/63	1125	SU-5	21	8.50	9.3	1.1	--	----	120	---	---
8/19/63	1625	SU-5	23	8.70	9.7	0.4	--	0.03	---	---	---
AVERAGE.			21	8.29	8.8	0.8	50	0.02	115	7.6	
8/20/63	0030	NU-1	19	8.00	8.8	1.3	22	0.12	---	1.8	---
8/20/63	0735	NU-1	18	7.90	8.9	1.3	--	0.09	---	2.3	---
8/20/63	1300	NU-1	20	8.18	9.3	1.2	--	0.12	---	---	---
8/20/63	1845	NU-1	21	8.56	9.3	1.9	--	0.08	---	---	---
AVERAGE.			20	8.16	9.1	1.4	22	0.10	---	2.0	
8/19/63	2335	NU-2	17	7.78	9.4	1.8	23	0.14	---	1.5	nil
8/20/63	0655	NU-2	15	7.70	9.5	1.4	--	0.18	---	2.1	---
8/20/63	1217	NU-2	17	8.06	10.5	1.4	--	0.13	---	---	nil
8/20/63	1805	NU-2	18	8.60	10.5	2.0	--	0.14	---	---	---
AVERAGE.			17	7.88	10.0	1.6	23	0.15	---	1.8	nil
8/20/63	1700	NU Spec.	20	8.10	9.7	2.8	22	0.09	---	---	---
8/20/63	0050	SU-1	23	8.98	8.5	2.0	68	0.39	---	10.2	---
8/20/63	0745	SU-1	20	8.24	7.0	2.1	--	0.37	---	10.6	---
8/20/63	1310	SU-1	23	8.89	10.7	1.7	--	0.35	---	----	---
8/20/63	1850	SU-1	23	9.48	12.1	2.2	--	0.39	---	----	---
AVERAGE.			22	8.90	9.6	2.0	68	0.38	---	10.4	---
8/20/63	0110	SU-2	22	8.55	8.9	1.2	68	0.08	---	10.2	---
8/20/63	0800	SU-2	21	8.52	8.1	1.8	--	0.06	---	10.4	---
8/20/63	1330	SU-2	23	8.40	6.2	2.0	--	0.07	---	---	---
8/20/63	1910	SU-2	24	8.80	9.3	2.2	--	0.12	---	---	---
AVERAGE.			22	8.57	8.1	1.8	68	0.08	---	10.3	---

(continued)

PHS WATER QUALITY SURVEY, UMPQUA RIVER BASIN (continued)

Date	Time	Station	Temp. °C	pH	Milligrams per Liter (mg/l) DO	BOD_5	Hardness	Sol. PO_4	Total Solids	Cl	B
8/19/63	2300	SU-3	22	8.30	8.2	1.8	67	0.11	--	9.1	---
8/20/63	0615	SU-3	20	7.89	7.7	1.5	--	0.07	--	10.0	---
8/20/63	1121	SU-3	22	8.18	8.7	1.6	--	0.10	--	--	---
8/20/63	1730	SU-3	25	8.90	9.8	2.5	--	0.09	--	--	---
AVERAGE.			22	8.32	8.6	1.8	67	0.09	--	9.6	---
8/20/63	2330	UR-1	23	8.62	9.1	2.2	--	-----	--	---	---
8/21/63	0555	UR-1	22	8.56	8.6	1.5	--	-----	--	---	---
8/21/63	1145	UR-1	22	8.62	8.8	1.4	--	-----	--	3.1	---
8/21/63	1720	UR-1	23	8.78	9.7	1.5	--	-----	--	3.1	---
AVERAGE.			22	8.64	9.0	1.6	--	-----	--	3.1	---
8/20/63	2230	UR-2	20	8.20	9.2	1.3	--	-----	--	---	nil
8/21/63	0500	UR-2	20	8.10	8.6	1.2	--	-----	--	---	---
8/21/63	1045	UR-2	20	7.94	8.6	1.4	--	-----	--	3.1	---
8/21/63	1630	UR-2	22	8.48	9.3	1.1	--	-----	--	3.0	---
AVERAGE.			20	8.18	8.9	1.2	--	-----	--	3.1	---
8/20/63	2350	EC-1	21	8.15	8.7	1.9	--	-----	--	---	-----
8/21/63	0605	EC-1	20	7.72	6.7	1.6	--	-----	--	---	-----
8/21/63	1200	EC-1	22	8.14	8.0	1.7	--	-----	--	16.4	-----
8/21/63	1730	EC-1	23	8.44	10.1	1.1	--	-----	--	15.9	-----
AVERAGE.			22	8.11	8.4	1.6	--	-----	--	16.2	-----
8/21/63	0030	EC-2	19	7.84	7.4	1.6	--	-----	--	-----	-----
8/21/63	0630	EC-2	17	7.90	7.6	1.6	--	-----	--	-----	-----
8/21/63	1245	EC-2	19	7.80	9.8	1.9	--	-----	--	27.7	-----
8/21/63	1800	EC-2	21	8.66	10.1	1.2	--	-----	--	31.7	-----
AVERAGE.			19	8.05	8.7	1.6	--	-----	--	29.7	-----

(continued)

PHS WATER QUALITY SURVEY, UMPQUA RIVER BASIN (continued)

Date	Time	Station	Temp. °C	pH	Milligrams per Liter (mg/l) DO	BOD_5	Hardness	Sol. PO_4	Total Solids	Cl	B
8/20/63	2240	CAL-1	21	8.06	8.9	2.1	--	--	--	---	---
8/21/63	0510	CAL-1	20	7.72	7.6	1.8	--	--	--	---	---
8/21/63	1100	CAL-1	20	7.62	8.1	1.0	--	--	--	5.2	---
8/21/63	1640	CAL-1	22	8.18	9.8	1.0	--	--	--	5.2	---
AVERAGE.			21	7.90	8.6	1.5	--	--	--	5.2	---
8/20/63	0110	CAL-2	22	7.84	8.9	1.5	--	--	--	---	---
8/21/63	0700	CAL-2	20	7.92	8.0	1.4	--	--	--	---	---
8/21/63	1315	CAL-2	22	7.90	8.2	1.5	--	--	--	4.9	---
8/21/63	1830	CAL-2	22	8.08	9.2	0.9	--	--	--	4.6	---
AVERAGE.			22	7.68	8.6	1.3	--	--	--	4.8	---
8/21/63	1340	CAL Spec.	19	8.10	8.7	1.0	--	--	--	2.2	--

* Trace = Less than 0.02 mg/l. Analytical procedure used not accurate for this amount.

NOTE: Tests were run on selected samples for the following ingredients and found to be nil: Turbidity, Color, Kjeldahl Nitrogen, & Suspended Solids.

APPENDIX C
1965 INVENTORY OF MUNICIPAL AND INDUSTRIAL WASTE SOURCES AND TREATMENT
UMPQUA RIVER BASIN, OREGON

Watercourse Community or Industry	River Mile	Est. Pop. 1960	Untreated Waste PE	Treatment	Design Capacity PE	Const. Date	Discharged Waste PE
South Umpqua River	112						
Tiller	112-75						
Tiller Ranger Sta.		--	50	Septic Tank	n/a*	n/a	0
Milo Academy	112-69	300	300	Secondary	450	1956	45
Canyonville	112-51	1,089	1,200	Secondary	2,400	1961	180
Cow Creek	112-47.2						
Glendale	112-47-41	748	900	Secondary	1,000	1957	150
Glendale Plywood		--	n/a	n/a	n/a	n/a	n/a
Robert Dollar Co.		--	n/a	n/a	n/a	n/a	n/a
Hanna Nickel Smelting Co.	112-47-6	--	Inorganic	Ponds	--	--	0
Riddle	112-47-2	992	1,000	Secondary	2,000	--	250
C&D Lumber Co.		--	n/a	n/a	n/a	n/a	n/a
Myrtle Creek	112-38	2,231	2,400	Secondary	3,000	--	480
Myrtle Cr. Plywood		--	n/a	n/a	n/a	n/a	n/a
VanDine Creek	112-36						
VanDine Meat Co.		--	750	Lagoon	--	--	0
Dillard	112-27	--	--	No system	--	--	--
Forest Ind. Inc.		--	n/a	n/a	n/a	n/a	n/a
Roseburg Lumber Co.		--	n/a	n/a	n/a	n/a	n/a
Douglas H. S.	112-25	600	600	Secondary	800	1963	90
Winston	112-21	2,395	1,800	Secondary	3,500	1957	300
Green S. D.	112-17	1,200	1,600	Lagoon	2,000	1963	240
Deer Creek	112-11						
Dixonville	112-11-1	--	n/a	n/a	n/a	n/a	n/a
Douglas Veneer Co.		--	n/a	n/a	n/a	n/a	n/a
N. Roseburg S. D.	112-10	6,500	7,500	Secondary	4,000	1951	1,100
Roseburg	112-8	11,467	15,000	Secondary	20,000	1958	2,400
Umpqua Dairy Products		--	(360)	City Sewer	--	--	--
Evans Products Co.		--	n/a	n/a	n/a	n/a	n/a
National Plywood		--	n/a	n/a	n/a	n/a	n/a
Town & Country Trailer Park		125	125	Secondary	300	1960	15

APPENDIX C
UMPQUA RIVER BASIN INVENTORY

Watercourse Community or Industry	River Mile	Est. Pop. 1960	Untreated Waste PE	Treatment	Design Capacity PE	Const. Date	Discharged Waste PE
North Umpqua River	112						
Lake Creek	112-94						
Diamond Lake Rec. Area	112-94-12						
Susan Creek State Park		--	50	Septic Tank	--	--	0
Glide	112-29	260	--	No system	--	--	--
Eugene Veneer Co.		--	n/a	n/a	n/a	n/a	n/a
Sutherlin Creek	112-5						
Sutherlin	112-5-8	2,452	2,700	Secondary	3,500	1956	500
Nordic Plywood		--	n/a	n/a	n/a	n/a	n/a
Calapooya Creek	102-7						
Oakland	103-15	856	--	No system	--	--	--
Martin Bros. Timber Co.		--	n/a	n/a	n/a	n/a	n/a
Elk Creek	49						
Yoncalla Creek	49-26						
Yoncalla	49-26-3	641	--	No system	--	--	--
Drain	49-24	1,052	1,000	Secondary	2,000	1960	150
Drain Plywood		--	n/a	n/a	n/a	n/a	n/a
Cloverleaf Packing Co.		--	100	Septic Tank	--	--	0
Elkton	48	--	--	No system	--	--	--
Reedsport	11	2,998	3,000	None	--	--	3,000
Reedsport Creamery & Cheese		--	1,000	None	--	--	1,000
U. S. Plywood		--	n/a	n/a	n/a	n/a	n/a
Gardiner	9	550	--	No system	--	--	--
International Paper Co.		--	120,000	Ocean outfall	--	--	0
Winchester Bay	2	1,000	1,000	None	--	--	1,000

*n/a - Not available